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DISPERSION OF FAST FLUCTUATIONS IN THE DECELERATION OF SATELLITES AT DIFFERENT ALTITUDES

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DISPERSION OF FAST FLUCTUATIONS IN THE DECELERATION OF SATELLITES AT DIFFERENT ALTITUDES

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ABSTRACT: Dispersions of relative fluctuations in the deceleration of satellites orbiting nearly at the same time on different heights were computed. It is shown that the change of dispersion with height agree with the idea [4] that the source of weekly thermal fluctuations is concentrated on an effective height Z_0 = (112-117) km.

As shown in [1], the reason for the weakly thermal fluctuations in the upper atmosphere is the variable ultraviolet solar radiation absorbed at an effective altitude Z_0 = 112-117 km. The thermal variations occurring at this level propagate to a height of at least 800 km [2] and cause rapid fluctuations in the deceleration of artificial earth satellites; the dispersion $\sigma^2(\tilde{P}_A)$ of the relative fluctuations [3] is /5*

$$\tilde{P}_A = \frac{\dot{P}_A - \bar{\dot{P}}_A}{\bar{\dot{P}}_A},$$

($\dot{P}_A$ is the rate of variation of the anomalistic period) increases with altitude to altitudes of at least 600-700 km. To be specific, the dispersion of the fluctuations increases proportionally to x^2, where

$$x = \int_{Z_0}^{Z_{\infty}} \frac{dz}{Hz}$$

is the "number" of altitudes of the homogeneous atmosphere from an effective absorption altitude Z_0 to the altitude of the satellites perigee z_c [4]. The transition from x to z_0 is given in Table 1. From this table it can be seen that at an altitude of $z_c \approx 600$ km the dispersion of the relative fluctuations should be approximately an order higher than at an altitude $z_c \approx 200$ km.

In order to verify this conclusion, the deceleration of several satellites orbiting at approximately the same time (near the solar-activity minimum) at different altitudes was analyzed [5, 6]. The results are given in Table 2. (In

*Numbers in the margin indicate pagination in the foreign text.

calculating the dispersion $\sigma^2(\tilde{P}_A) = \tilde{P}_A^2$, the values of $\tilde{P}_A$ were taken at intervals of 8-12 hours, where they are essentially uncorrelated.)

TABLE 1

Z_c	200 km	400 km	600 km
$\varkappa$	3 to 4	6 to 7	8.5 to 9.5

TABLE 2

Object	Processing interval	Sampling volume	Z_c (km)	$\sigma^2(\tilde{P}_A)$
Injrin-3	Jan. 1963-Feb. 1964	94	230	0.013 ± 0.002
Explorer-1	Jan. 1962-Apr. 1964	96	340	0.038 ± 0.006
Explorer-8	Jan. 1962-Aug. 1963	66	420	0.07 ± 0.01
Vanguard-3	Jan. 1962-Sep. 1962	26	510	0.12 ± 0.04
Vanguard-2	Jan. 1962-Aug. 1963	57	560	0.12 ± 0.03
Explorer-9	Jan. 1962-Aug. 1963	70	660 + 750	0.06 ± 0.01

As is evident from Table 2, there is no contradiction between theory and experiment.

REFERENCES /6

1. Chertoprud, V.E.: Astron. Circular; No. 458 (1968).
2. Chertoprud, V.E.: Obs. of Art. Earth Sat.; No. 5 (1966).
3. Chertoprud, V.E.: Astron. Circular; No. 413 (1967).
4. Chertoprud, V.E.: Sci. Info. of the Astron. Council; No. 9 (1968).
5. Jacchia, L. and J. Slowey: J. SAO Sp. Rep. No. 171 (1965).
6. Satellite orbital data, SAO, Sp. Rep. Nos. 142, 159, 169, 208.

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